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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/857,774 | 06/11/2001 | Ho-Yong Lee | LEE 78 | 9764 |

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EXAMINER

ANDERSON, MATTHEW A

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 03/13/2003

8

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/857,774

Applicant(s)

LEE ET AL.

Examiner

Matthew A. Anderson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 December 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 and 16-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-14 and 16-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 31 December 2002 is: a) ☒ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-3, 5-7, 9-11, 14, 16-20 are rejected under 35 U.S.C. 102(e) as being anticipated by Harmer et al. (US 6,048,394).

Harmer et al. discloses the method for growing single crystal from polycrystalline precursors. A seed crystal plate is bonded to a polycrystalline structure and annealed to form a single crystal as in Fig.1 (see abstract) The grown crystal has some in-grown porosity as seen in Fig. 9A. The specific perovskites named by Harmer et al. are the relaxors $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$, [commonly known by the acronym PMN], $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{O}_3$ or commonly PZN, and their solid solutions with PbTiO_3 or PT. BaTiO_3 is also described as subject to such grain boundary curvature driven grain growth in col. 1 lines 55-60 and col. 4 lines 33-40). (Park et al. discloses the inherent perovskite structure of these materials in US 5,804,907 col. 1 lines 40-50.) The orientation of the seed was important and $\langle 100 \rangle$, $\langle 111 \rangle$, and $\langle 110 \rangle$ were described as possible growth directions. ($\langle 111 \rangle$,

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<110>, <100> from fastest to slowest growth direction). Col. 4 lists result effective variable that affect the velocity of the grain boundary as the single crystal grows into the polycrystalline matrix. These are polycrystalline size, temperature, pore drag effects, and the presence of a liquid phase. The liquid phase was formed by deliberately adding a second component such as lead oxide, lead aluminate, etc which has a lower melting point than the major constituent (PMN-PT). Hot pressing was then possible from achieving low porosity. Annealing occurred then at 900-1200'C for up to 50 hours in a closed crucible. The heat (see col. 5 lines 1-5) causes the seed crystal to grow into the polycrystalline matrix under the influence of grain boundary curvature. (Grain boundary curvature driven recrystallization is described by Kingery et al. to be known by many names including secondary recrystallization, or discontinuous or exaggerated grain growth and to occur when one grain grows into the polycrystalline matrix at the expense of other grains due to grain boundary curvature. Page 461.) A small amount of the wetting second phase is added in the matrix and around the seed crystal to enhance rapid growth of the single crystal.. (see col. 5 lines 5-20.) The components of the perovskite are described specifically and are thus controlled. Lead oxide is disclosed as added in excess to cause a liquid phase and thus to promote the abnormal grain growth of the seed due to grain boundary curvature.. Processing variables are disclosed in col. 2 and col. 3 lines 65+ and 1-5 respectively including grain size of the polycrystal, crystal orientation, interface chemistry, polycrystal chemistry, thermal gradient across the polycrystal/single crystal interface and processing variables. The seed has a plate shape in Fig. 1.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 4, 8, 12, 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harmer et al. (US 6,048,394).

Harmer et al. is disclosed above and suggests using a temperature gradient in col. 2 lines 4-5. Porosity effects on the dielectric constant were suggested in col. 3 lines 35-45.

Harmer does not specify the nature of the temperature gradient.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the temperature gradient between the seed crystal and the polycrystalline matrix because Harmer et al. suggested that the thermal gradient causes result effective changes in the processing behavior and such optimization would have been achieved with only routine experimentation.

It would have been obvious to use the single crystal produced in the method as the seed crystal for the process because then uniform structure would be expected.

The examiner notes that the intended use of the product does not materially affect the obviousness of the method.

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It would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the porosity of the single crystal by addition of porosity to the perovskite because porosity was seen to affect the dielectric constant (col. 3 lines 35-45)and such optimization would have been achieved with only routine experimentation.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the additive composition of the single crystal perovskite because Harmer et al. suggested interface chemistry as an important process parameter and such optimization would have been achieved with only routine experimentation.

5. Claims 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harmer et al. as applied to claims 1-14, 16-20 above, and further in view of Kingery et al. (Introduction to Ceramics, Second Ed., John Wiley& Sons, New York, pp. 452-455, 461-468), 1976.)

Harmer et al. is disclosed above.

Harmer et al. does not suggest PZT ceramics.

Kingery et al. discloses on page 461 that abnormal grain growth is common in oxides, titanates, and barium titanate ceramics.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to grow the PZT perovskite crystal with the seed crystal annealing of

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Harmer et al. because abnormal grain growth was known to be common in perovskite materials and was demonstrated by Harmer et al. to work in such chemical systems.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the size of the polycrystal grains because such is suggested by Harmer et al. in col. 2 lines 1-3.


Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (703) 308-0086. The examiner can normally be reached on M-Th, 6:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

MAA
March 6, 2003


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